



***Environment Goals:
Emissions and Noise
Aeronautics & Space Transportation
Technology: Three Pillars for Success***

3rd Workshop on NASA's Environmental Compatibility Research
Monterey, CA
July 7, 1998

Howard L. Wesoky
Team Leader
Environmental Compatibility Assessment

Environmental Compatibility Assessment Core Team



Charter: The Environmental Compatibility Assessment (ECoA) Core Team has been directed by the Executive Board of the NASA Office of Aeronautics & Space Transportation Technology to assess the ability of current programs to achieve the “Three Pillar” Emissions and Noise goals and to recommend what additional effort may be required.

Vision: In collaboration with carriers, manufacturers, academia, other government agencies **and NGO’s**, NASA will develop robust technology options with the objective that environmental issues do not constrain the growth of air transportation.

Environmental Compatibility Assessment Core Team Members



Office of Aeronautics & Space Transportation
Technology: Howard Wesoky, Team Leader

Ames Research Center: Chuck Smith, Paul Soderman

Dryden Flight Research Center: Ron Ray

Langley Research Center: Doug Dwoyer, Dave
Stephens

Lewis Research Center: Carol Russo, John Rohde

Assisted by HQ Support Contractor: SAIC

ASTTAC Task Force on NASA's Aviation Environmental Compatibility Research: Charter

1. Based on examining past application of NASA research, recommend ways to improve effectiveness of environmental technology transfer.
2. Evaluate process being used to assess and recommend NASA research plans in noise and emissions relative to the "Three Pillars" environmental goals.
3. Recommend ways to ensure the appropriate use of research in regulatory considerations.
4. Recommend ways of improving the relationship of NASA with the air carrier community, aircraft and engine manufacturers, other environmental research and technology organizations, and regulatory agencies with regard to environmental research and technology.
5. Identify critical interdependencies of environmental goals with the other related "Three Pillar" goals.

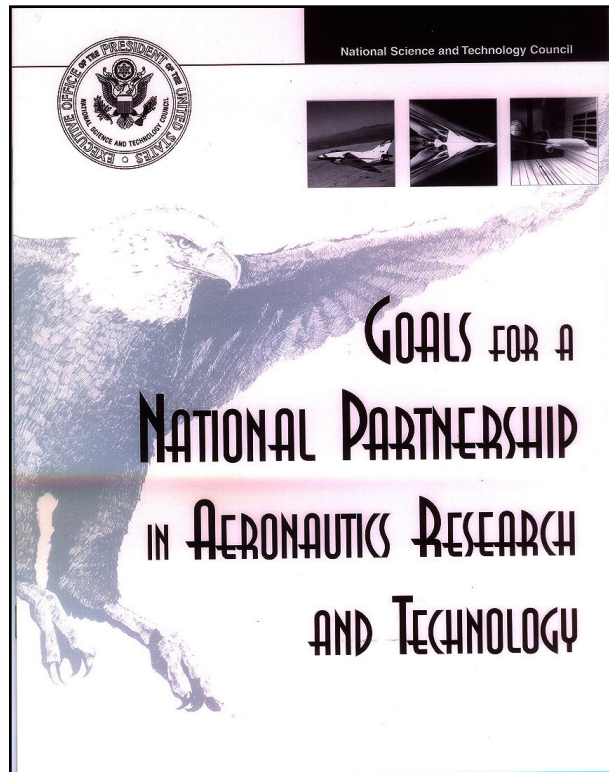
Final report due August 31, 1998



ASTTAC Task Force on NASA's Aviation Environmental Compatibility Research: Members

- Mike Benzakein, GE, Chairperson
 - Tom Auxier, P&W
 - John Begin, Northwest Airlines
 - Bob Cuthbertson, Boeing Commercial Airplanes
 - Julie Ellis, FedEx
 - James Erickson, FAA
 - Wes Harris, MIT
 - Ram Janakiram, Boeing Helicopter
 - Max Malone, United Air Lines
 - Bill Schultz, Gen Aviation Manufacturers Association
 - Paul Stolpman, EPA
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- Howard Wesoky, NASA, Exec Secretary
 - Darlene Boykins, NASA, Administrative Assistant

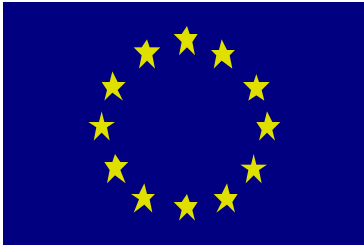
White House Policy



- Maintain superiority of US aircraft and engines
- Improve safety, efficiency, and cost effectiveness of global air transportation system
- **Ensure long-term environmental compatibility of aviation system**

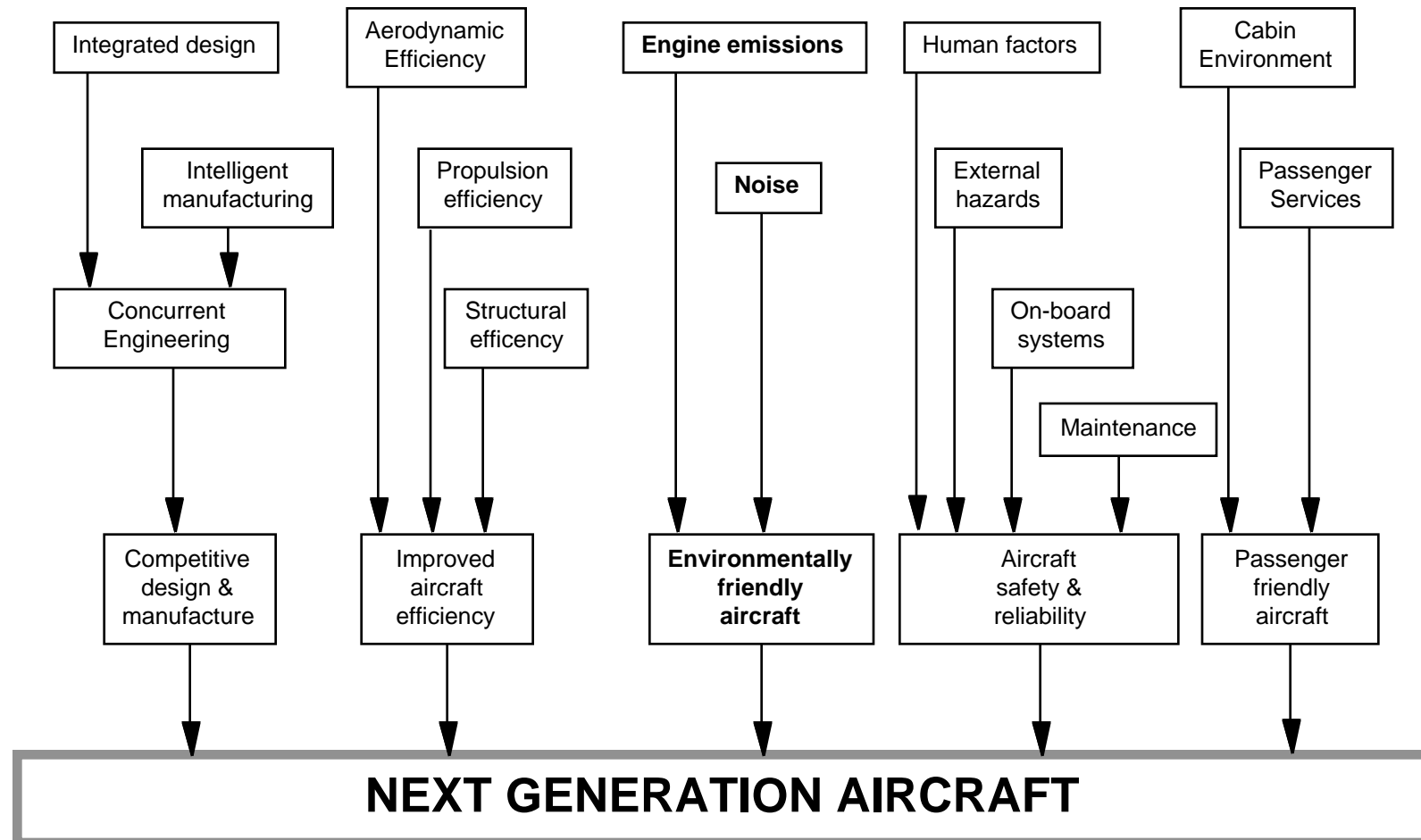
“Past research investments in technologies to reduce engine noise and emissions are paying dividends today. But more needs to be done. Environmental issues are likely to impose the fundamental limitation on air transportation growth in the 21st century.”

National Science & Technology Council, August 1995



European Commission AERONAUTICAL RESEARCH

A coordinated approach to the aircraft of the next generation



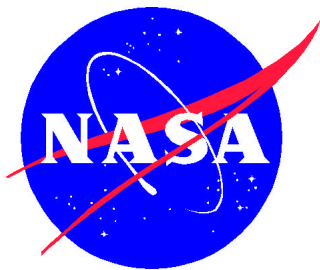
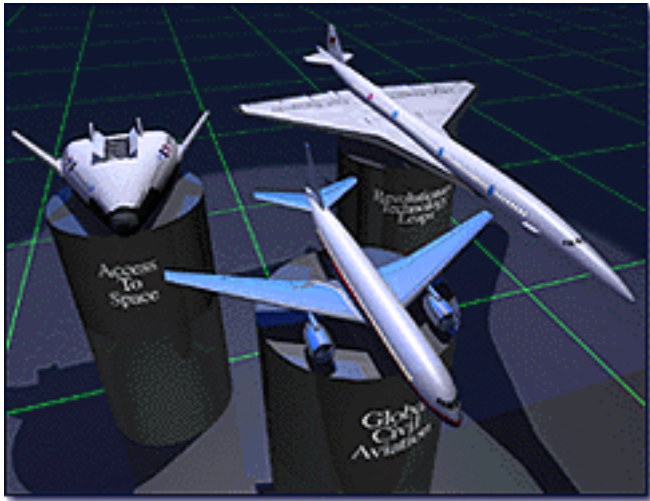
National Research Council



“The public will continue to demand reductions in environmental damage and reductions of acoustic noise over urban areas. This will require the United States to collaborate with other nations to develop technology that will reduce or eliminate harmful aircraft engine emissions and technology that will enable quieter engines and operations, including revolutionary means to mitigate sonic boom effects over populated areas.”

Maintaining U.S. Leadership in Aeronautics:
Scenario-Based Planning for NASA's Aeronautics Enterprise,
Aeronautics & Space Engineering Board,
National Academy Press, 1997

Aeronautics & Space Transportation Technology: Three Pillars for Success



- *“We believe there are technological solutions that will significantly reduce aircraft emissions that contribute to global warming and ozone depletion, even as travel volume increases.”*
- *“Can we go further and create aircraft that are so quiet that the predominant noise at airports comes from cars and buses?”*

Aeronautics and Space Transportation Technology: Three Pillars for Success

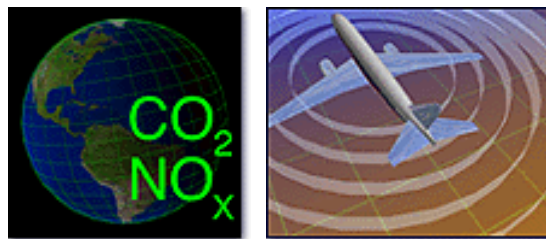


“Throughout the pillars we present ‘technology goals’ which are framed in terms of a final outcome, the anticipated benefit of NASA-developed technology, once it has been incorporated by industry.”

Enabling Technology Goals

- **“Reduce emissions of future aircraft by a factor of three within 10 years, and by a factor of five within 20 years.”**
- **“Reduce the perceived noise levels of future aircraft by a factor of two from today’s subsonic aircraft within 10 years, and by a factor of four within 20 years.”**

“Both of these environmental goals have the requirement to be achieved without affecting safety or affordability.”



Emissions Mandate



KYOTO Challenge to Aviation (Dec 11, 1997)

Kyoto Protocol Article 2, paragraph 2:

"The Parties included in Annex 1 shall pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal protocol from aviation working through the International Civil Aviation Organization..."

Greenhouse gases

Carbon dioxide	Hydrofluorocarbons
Methane	Perfluorocarbons
Nitrous oxide	Sulphur hexafluoride

President Clinton's Climate Change Proposal (Global Climate Change Policies -- October 22, 1997)

ICAO Actions on LTO Emissions

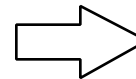
Standard for Gaseous Emissions

- » unburned hydrocarbons
- » smoke
- » carbon monoxide
- » oxides of nitrogen

CAEP 2 - NO_x Reduction of 20%; effective 1996

CAEP 4 (April 1998) - Further NO_x reduction of 16%

Montreal Protocol, 1987



Global Warming Reversal

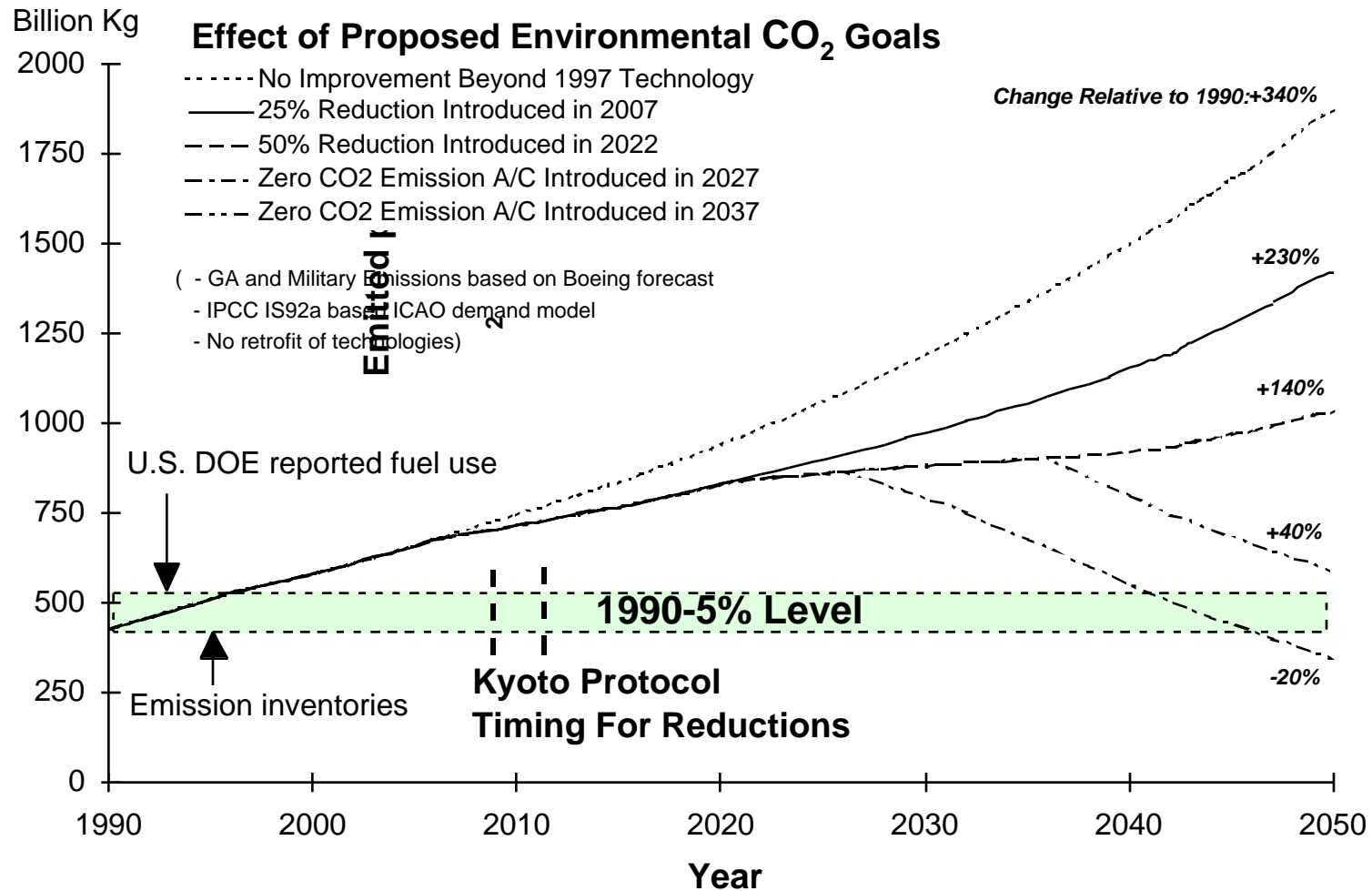
Improved Local Air Quality

Ozone Depletion Recovery

NASA Needs to Take the Leadership in Providing Aircraft Emissions Reduction Technologies to Enable Continual Growth in Air Transportation



Aviation and the Kyoto Protocol



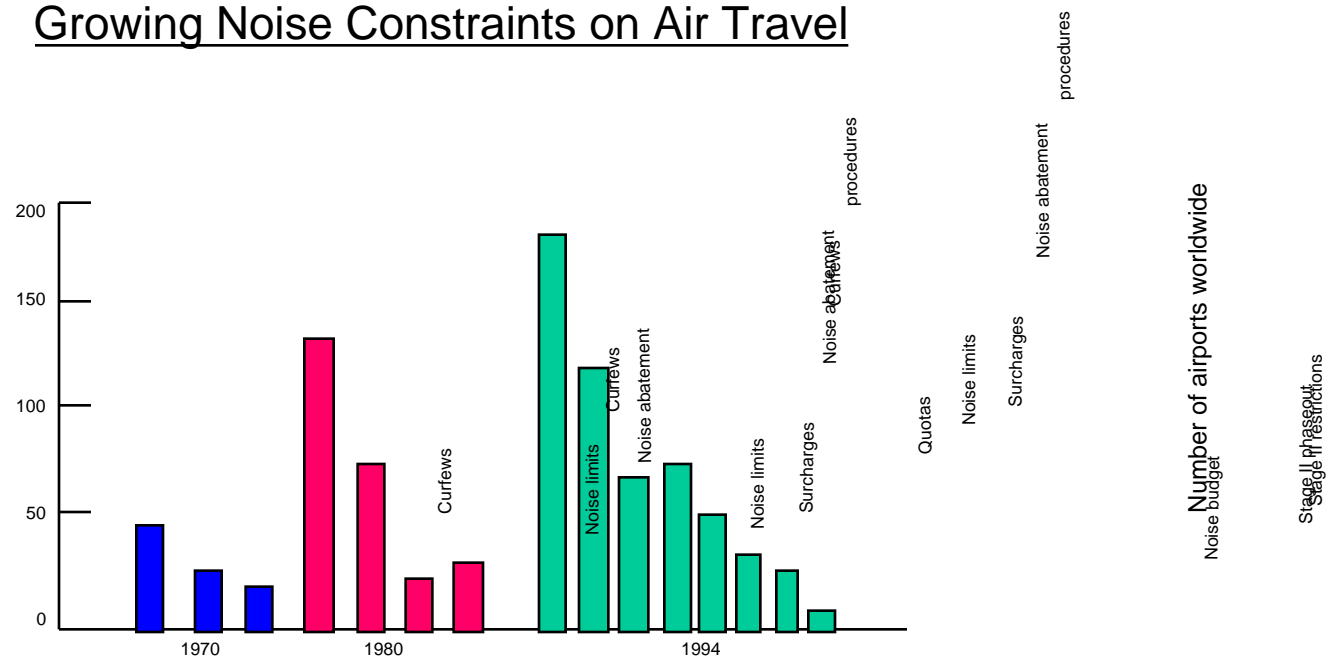
Effectiveness of Advanced Technology In Reducing Total CO₂ Emitted From Aircraft

Noise Mandate



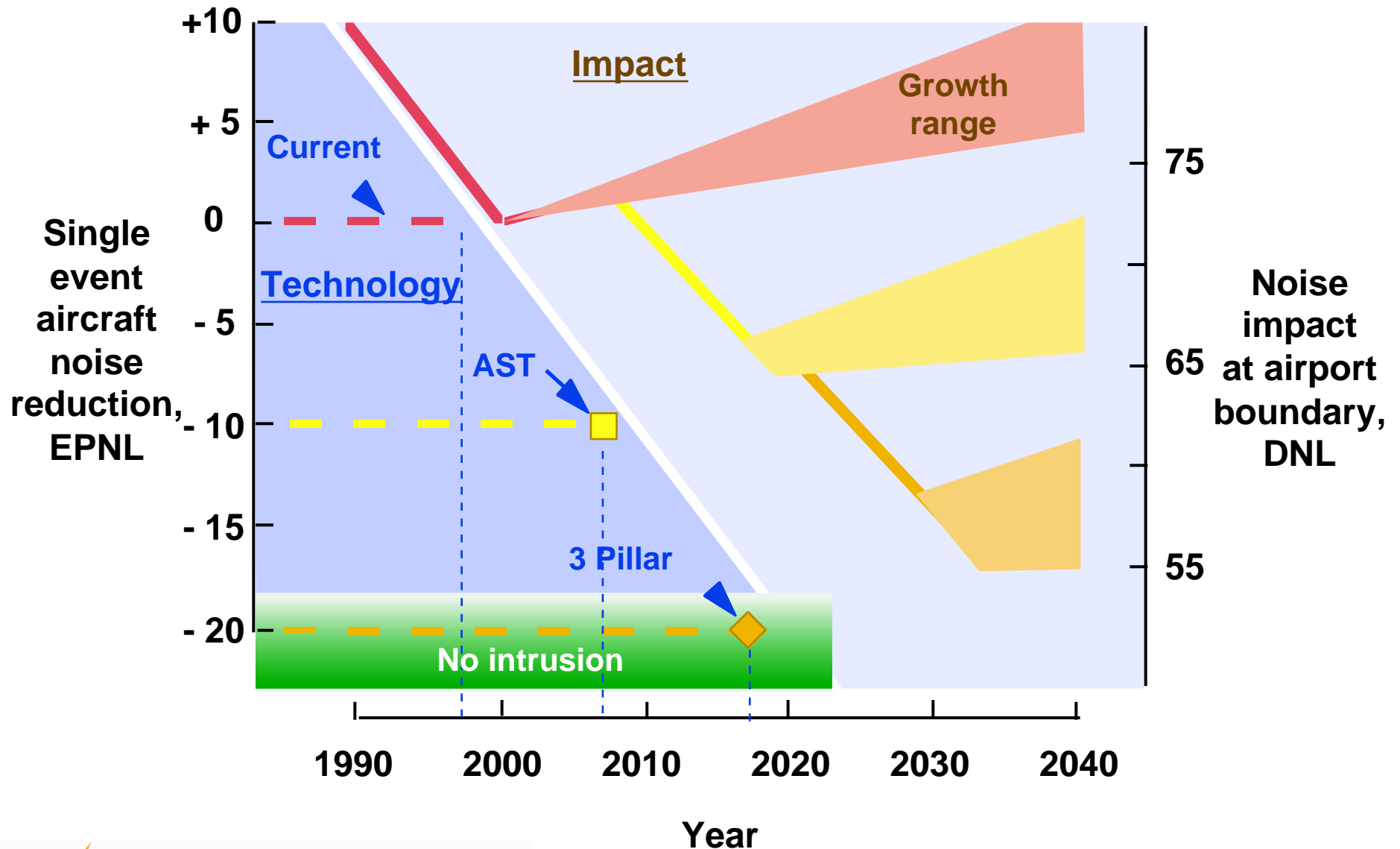
- Meet international regulations (increased stringency) and local rules
- Maintain and improve competitiveness of air transportation

Growing Noise Constraints on Air Travel



NASA Needs to Take the Leadership in Providing Aircraft Noise Reduction Technologies to Enable Continual Growth in Air Transportation

Aircraft Noise Reduction And Community Impact



“Public” Workshops on NASA’s Environmental Compatibility Research



1. What are the impacts of aviation noise and emissions on the environment?
2. How do you believe those impacts may affect the growth of aviation?
3. Must the growth of aviation lead to increased environmental impact?
4. What is the relationship of NASA’s noise and emissions goals to aviation’s impact on the environment?

Workshop Objectives



Workshop #1: Shared learning, coalition building with a large, wide group of participants.

- What are the environmental issues that are likely to impose fundamental limitations on aviation's growth?
- What are the technical challenges faced in eliminating the fundamental limitations to aviation's growth?

“Customer” problems and issues, clarification of “benefits.”

Workshop #2: Review customer needs and benefits, develop roadmaps.

- Review scenarios
- First cut gap analysis
- Strawperson roadmaps
- Customer benefits

Workshop #3: Suggest research and technology areas, refine roadmaps, and chart way forward.

- Review roadmaps
- Priorities - What needs to be started now?
- Fostering creativity
- The way forward

Basis for initiating a search for technology solutions.

Clear program options!

Workshops



I. Atlanta, GA

March 17-19

II. Cleveland, OH

May 19-21

III. Monterey, CA

July 7-9

Workshop I & II

Attendees



- NASA HQ, ARC, DFRC, GSFC, LaRC, LeRC
- Other govt: DoD, EPA, FAA, OSTP, White House Climate Change Task Force
- Universities: Georgia Tech, U of Maryland, MIT
- Industry associations: AIA, ATA, GAMA
- Manufacturers: Allison, Boeing, GE, Allied Signal, P&W, Lockheed Martin, Northrop Grumman, BF Goodrich, TRW
- Air carriers: Delta Air Lines, United Air Lines
- Airports: Dallas-Fort Worth, San Jose, LAX, PONY/NJ, Nashville, SeaTac
- NGO's: Center for Clean Air Policy, Environmental Defense Fund, National Organization to Insure Sound Environment, Natural Resources Defense Council
- Others: Aerodyne Research, HMMH, Transportation Solutions, GRA, Wyle Labs, Mitre, Cutler & Stanfield, Landrum & Brown, McDermott, Will, & Emery, Camp Dresser & McKee Inc

Summary



- Strong mandate for NASA to initiate significant investment towards “Three Pillars” emissions and noise goals

National Aeronautics and Space Act of 1958: The aeronautical and space activities of the United States shall be conducted so as to contribute materially to . . . The expansion of human knowledge of phenomena in the atmosphere . . . The improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles . . . The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere.